

A Versatile Parametric X Ray Source

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Parametric x rays are generated as a relativistic electron passes through a crystal. The x rays are emitted at the Bragg angle, with very nearly the Bragg energy associated with the initial electron trajectory. As an x-ray source, PXR has several characteristics that suggest a variety of applications. When the crystal is “rocked”, the Bragg angle and PXR energy shift in the usual fashion, so that PXR might be used as a tuneable x-ray source. The radiation mechanism is relativistic, so that the PXR beam is collimated with characteristic divergences of about $1/\gamma$, where γ is the electron energy divided by the rest mass. Although the radiation efficiency is modest ($\approx 10^{-5}$ photon/electron), this still is adequate for a variety of scientific applications.

One interesting set of applications relate to using PXR as an alternative source on a facility whose primary purpose relates to other electron-beam applications. For example, PXR could serve as a useful x-ray source with a storage-ring injector, during periods when the injector is idle. This becomes more attractive when the PXR source can be designed to be simple and inexpensive, but still serve as a versatile x-ray source. In the present case, it is possible to design a PXR source with a single rotating part which can provide tuneable x-rays with energies that span a factor of twenty, or more to a target spot that is stable to within one millimeter. Thus, for applications such as detector calibrations or foil-transmission measurements, such a system could make excellent use of otherwise lost time on storage-ring injectors.

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